UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/481,771	01/11/2000	Karl Michael Isham	PHA 23,656	6085

24737	7590	04/19/2004		

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

EXAMINER
ALI, SYED J

ART UNIT	PAPER NUMBER
2127	

14

DATE MAILED: 04/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 January 2004*.

2a)☐ This action is **FINAL.**   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-3,5-10,12-18 and 20-22* is/are pending in the application.

     4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,6-10,13-18,21 and 22* is/are rejected.

7)☒ Claim(s) *5,12 and 20* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *21 January 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

     a)☐ All   b)☐ Some * c)☐ None of:

         1.☐ Certified copies of the priority documents have been received.

         2.☐ Certified copies of the priority documents have been received in Application No. _____.

         3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
application from the International Bureau (PCT Rule 17.2(a)).

     * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☐ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
     Paper No(s)/Mail Date *13*.

4)☐ Interview Summary (PTO-413)
     Paper No(s)/Mail Date. _____ .

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____.

DETAILED ACTION

1.   A request for continued examination under 37 CFR 1.114, including the fee set forth in

37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex*

Parte Quayle, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible

for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been

timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114.

Applicant's submission filed on January 21, 2004 has been entered.

2.   Claims 1-3, 5-10, 12-18, and 20-22 are presented for examination.

3.   The text of those sections of Title 35, U.S. code not included in this office action can be

found in a prior office action.

Allowable Subject Matter

4.   The indicated allowability of claims 1-3, 5-10, 12-18, and 20-22 is withdrawn in view of

the newly discovered reference to Klein et al. ("A Practitioner's Handbook for Real-Time

Analysis: Guide to Rate Monotonic Analysis for Real-Time Systems") (hereinafter Klein).

Rejections based on the newly cited reference follow.

5.   Claims 5, 12, and 20 are objected to as being dependent upon a rejected base claim, but

would be allowable if rewritten in independent form including all of the limitations of the base

claim and any intervening claims.

Claim Rejections - 35 USC § 103

6.   Claims 1-3, 6-10, 13-18, and 21-22 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Klein in view of Sha et al. (previously cited) (hereinafter Sha).

As per claim 1, Klein teaches the invention as claimed, including a method for sharing

execution capacity among tasks executing in a real-time computing system having a performance

specification in accordance with Rate Monotonic Analysis [RMA], comprising the steps of:

pairing a higher priority task with a lower priority task (§4-55);

reallocating execution time from the lower priority task to the higher priority task during

a busy period (§4- 55, 58);

increasing the period of the lower priority task to compensate for said reallocated

execution time (§4-59; step 6); and

limiting an amount of execution time, N_r, to borrow from said lower priority task, $task_r$,

to a maximum loan amount where $N_r \ll C_r$ (§4-56, 57; steps 3-6), where

C_r = worst-case task execution time of $task_r$ (§4-56; step 1), and

N_r = amount of execution time to borrow from $task_r$ (§4-56, 57; steps 1-6).

Sha teaches the invention as claimed, including that the reallocation of execution time

occurs during an overload condition (§4.2, pgs. 258-259).

It would have been obvious to one of ordinary skill in the art to combine Klein and Sha

since the reallocation of execution time during a busy period as taught by Klein does not specify

the type of busy condition. Adjustments are made to the allocated execution time for a task

during this busy period to ensure that all tasks meet their scheduling requirements. Sha teaches a

remedy for handling transient overload conditions, which may require immediate intervention to

ensure high processor utilization and provide that all tasks meet their deadlines. Furthermore,

Sha teaches of period transformation to account for adjustments in allocated execution times,

such that the total processor utilization remain constant for a constant number of tasks, while

remaining below a maximum bound if a single task is broken up into multiple tasks. The

combination on Klein and Sha therein provides several options regarding adjustment of

scheduling resources to ensure that all tasks meet specified deadlines.

As per claim 2, the combination of Klein and Sha teach the invention as claimed,

including the method of claim 1, wherein an amount of said execution time available to loan

from said lower priority task [hereinafter $task_r$] to said higher priority task [hereinafter $task_u$] is

obtained as follows:

$$N_u = (N_r * T_u) / T_r$$

where,

N_r = amount of execution time to borrow from $task_r$, where $N_r < C_r$,

T_r = period of $task_r$,

C_r = worst-case task execution time of $task_r$, and

T_u = period of $task_U$.

Specifically, since the task utilization of any one task is defined by both Klein (§4-10;

step 1) and Sha (pg. 245) to be C_n / T_n, certain modifications to that formula must occur if

execution time is being taken away from a task. Klein teaches that *one* utilization bound exists

for an entire situation, and is constant regardless of adjustments made to the scheduling of individual tasks (§4-10). Furthermore, Sha teaches that when a period of a task is transformed, the utilization for the task remains constant (pg. 259). C_n is defined as the worst-case execution time of a particular task, and T_n is the period of that task. When borrowing execution time, a certain amount of execution time must be added to C_n for the task borrowing the time, and a certain amount of execution time must be subtracted from C_n for the task lending the time. By assuring that the total task utilization for the two tasks combined is to remain constant, it is a simple derivation to arrive at the formula that is claimed, and one that would have been obvious to one of ordinary skill in mathematics. Therefore, "Official Notice" is taken that it would have been obvious to one of ordinary skill in the art to define the amount of execution time as above, based on the task utilization bounds defined in Klein (§4-10; step 1) and Sha (pg. 245) and the idea that the total combined task utilization should remain a constant.

As per claim 3, the combination of Klein and Sha teach the invention as claimed, including the method of claim 1, wherein said increased period of the lower priority task, $task_r$, is obtained as follows:

$$T_n = (C_r * T_r) / (C_r - N_r)$$

where

C_r = worst-case task execution time of $task_r$,

T_r = period of $task_r$, and

N_r = amount of execution time to borrow from $task_r$, where $N_r < C_r$.

As discussed above in reference to claim 2, any alterations in the execution time or period of a particular task has to accounted for such that the total task utilization does not exceed the bounds defined for the number of tasks running. As such, when execution time is lent to another task of a higher priority, a compensation needs to occur by increasing the period of the task lending the time such that the total utilization for both tasks remain a constant. Thus, the expression $(C_r / T_r) + (C_u / T_u) = [(C_r - N_r) / T_n] + [(C_u + N_u) / T_u]$ is the logical result that would allow the total task utilization for the two combined tasks to remain a constant based on the defined total task utilization bound taught by Klein (§4-10; step 1) and Theorem 1 of Sha (pg. 245). Further, the value of T_n, the new period for the lower priority task, can be solved for using Theorem 1 of Sha and the formula arrived at in claim 2.

As per claim 6, Klein teaches the invention as claimed, including the method of claim 1, wherein said higher priority task has hard deadlines (§3-21, 22).

As per claim 7, Klein teaches the invention as claimed, including the method of claim 1, wherein said lower priority task has soft deadlines (§3-21, 22).

As per claims 8-10 and 13-14, they are rejected for similar reasons as stated above for claims 1-3 and 6-7, respectively. Klein teaches the spare capacity associated with a lower priority task can be borrowed by a higher priority task under several conditions. Those conditions include, but are not limited to, busy periods of operation or tasks being blocked for a specified term. The conditions under which processing capacity can be borrowed include a

superset of the condition claimed in independent claim 8. Furthermore, the equations that define

the bounds on execution time to borrow are the same as those presented in claims 1-3 and 6-7,

respectively. Therefore, the methodology associated with borrowing execution time taught by

the combination of Klein and Sha therein is applicable to the present set of claims as well.

As per claims 15, 17-18, and 21-22, they are rejected for similar reasons as stated above

for claims 1, 2-3, and 6-7, respectively. Klein teaches the additional limitation presented that the

utilization bound for a set of tasks should remain a constant (§4-10; step 1). Additionally, Sha

teaches that when the period of a higher priority task is transformed, the utilization of that task is

inherently increased (pg. 259). If total task utilization is to remain constant, the utilization of the

lower priority task, from which execution time is borrowed, must be reduced proportionally to

the increase in utilization of the higher priority task such that the utilization bound remains a

constant as taught by Klein (§4-10; step 1). Furthermore, the equations that define the bounds on

execution time to borrow are the same as those presented in claims 1, 2-3, and 6-7, respectively.

Therefore, the methodology associated with borrowing execution time taught by the combination

of Klein and Sha therein is applicable to the present set of claims as well.

As per claim 16, Klein teaches the invention as claimed, including the method of claim

13, wherein said utilizations of said tasks are varied as follows:

$$(C_u / T_u) + (C_r / T_r) = U \leftarrow \text{shown by Klein at §4-10; step 1.}$$

where,

C_u = worst-case task execution time of $task_u$,

T_u = period of task$_u$,

C_r = worst-case task execution time of task$_r$,

T_r = period of task$_r$,

U = utilization for both tasks.

Conclusion

7.   Any inquiry concerning this communication or earlier communications from the examiner should be directed to Syed J Ali whose telephone number is (703) 305-8106. The examiner can normally be reached on Mon-Fri 8-5:30, 2nd Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Meng-Ai T An can be reached on (703) 305-9678. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Syed Ali
April 5, 2004

MENG-AL TAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100